ADVANCED FUNCTIONAL MATERIALS

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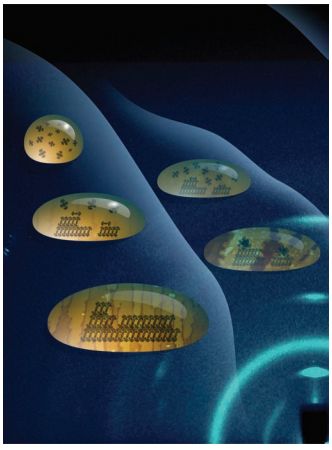
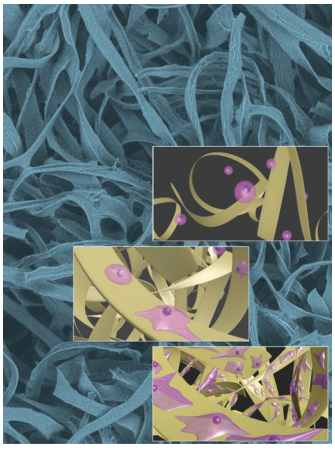


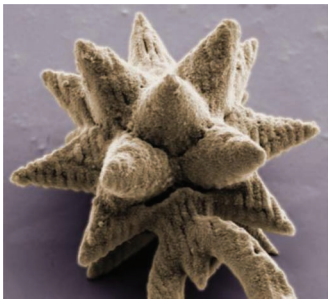
Field-Effect Transistors

In printed electronics, the drying semiconductor solution undergoes a solution-to-solid phase transformation that must yield optimal microstructure and performance. In small-molecule organic field-effect transistors (OFETs), it is crucial to yield films with large area lamellar coverage with excellent in-plane p-stacking. On page 291 Aram Amassian and co-workers present new methodology and insight, which help to ensure that the drying solution crystallizes in optimal ways to promote carrier transport in OFETs.

Tissue Engineering

Fan Yang and co-workers report on page 346 that microribbon-like, photo-crosslinkable elastomers form macroporous tissue engineering scaffolds, which facilitate cell encapsulation and cell proliferation in three dimensions. The unique geometry of microribbons leads to scaffolds with superior flexibility, which can sustain repetitive compression without failing. Such scaffolds could be particularly useful for engineering shock-absorbing tissues such as articular cartilage and intervertebral discs.





Multiphoton Lithography

Multiphoton lithography using a solid, protein-based reagent creates microstructures free from previous requirements for surface attachment. On page 333 Jason B. Shear and co-workers report the use of this approach to fabricate a broad range of micro-scale objects using several proteins. Freefloating 3D protein stars are confined with bacteria within microscopic chambers, providing a means to probe cellular activity using objects of defined shape. This method provides a tool for investigators to define and characterize cellular microenvironments.

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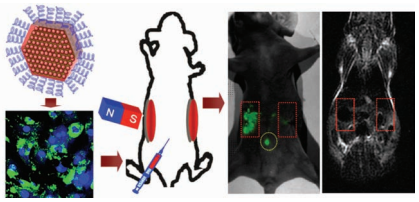
Biomedical Applications

L. Cheng, C. Wang, X. X. Ma, Q. L. Wang, Y. Cheng, H. Wang, Y. G. Li, Z. Liu*.....272–280

Multifunctional Upconversion Nanoparticles for Dual-Modal Imaging-Guided Stem Cell Therapy under Remote Magnetic Control

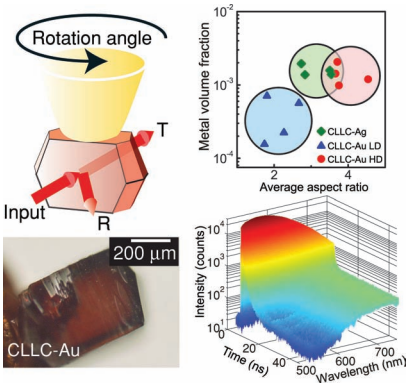


A unique class of multifunctional nanoparticles with both upconversion luminescence and superparamagnetic properties is used for in vivo multimodal stem cell tracking. Ultrahigh sensitivity is achieved at almost the single cell level. Enhanced tissue repair is further realized as the result of magnetically induced accumulation of nanoparticle-labeled stem cells in the wound site.

Hybrid Materials

O. L. Muskens,* M. W. England, L. Danos, M. Li, S. Mann*.....281–290

Plasmonic Response of Ag- and Au-Infiltrated Cross-Linked Lysozyme Crystals

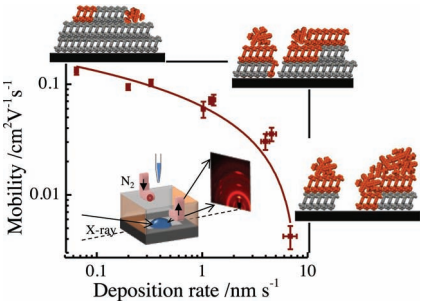


Cross-linked lysozyme crystals infiltrated with Au or Ag form a novel hybrid optical material with a strong plasmonic response. Absorption measurements of infiltrated crystals with up to 36% in weight of Au or Ag can be fitted using a distribution of isolated ellipsoidal particles, while fluorescence lifetime spectra reveal contributions from quenched protein fluorescence and characteristic emission from small Au-nanoclusters.

Field-Effect Transistors

R. Li, H. U. Khan, M. M. Payne, D.-M. Smilgies, J. E. Anthony, A. Amassian*.....291–297

Heterogeneous Nucleation Promotes Carrier Transport in Solution-Processed Organic Field-Effect Transistors

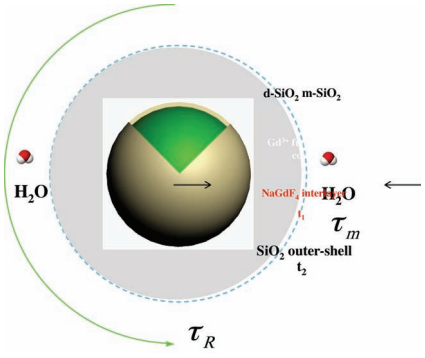


A new way to investigate and control the growth of drop-cast thin films is presented. The solution-processing of small-molecule thin films of TIPS-pentacene is investigated using time-resolved techniques to reveal the mechanisms of nucleation and growth leading to solid film formation. By tuning the drying speed of the solution, the balance between surface and bulk growth modes is altered, thereby controlling the lamellar formation and tuning the carrier mobility in organic field-effect transistors

Nanoparticles

F. Chen, W. Bu,* S. Zhang, J. Liu, W. Fan, L. Zhou, W. Peng, J. Shi*.....298–307

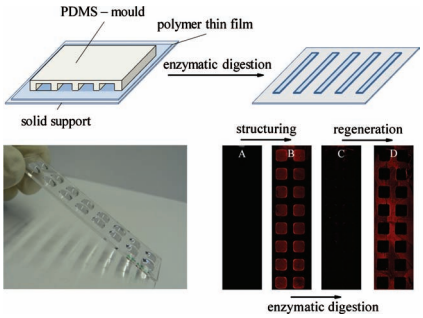
Gd^{3+}-Ion-Doped Upconversion Nanoprobes: Relaxivity Mechanism Probing and Sensitivity Optimization



Relaxivity mechanism probing shows that longitudinal relaxivity enhancement of Gd^{3+}-doped upconversion nanoparticles (UCNPs) originates from inner- and outer-sphere mechanisms for ligand-free probes, and mainly from an outer-sphere mechanism for silica-shielded probes. The origin of transverse relaxivity is inferred to be mainly from an outer-sphere mechanism, regardless of surface-modification but with the transverse relaxivity (r_2) values highly related to the surface-state.

FULL PAPERS

The microstructuring of nanometric polymer thin films is demonstrated by two methods. Enzymatic digestion in combination with soft-lithography is used to obtain patterned surfaces. Alternatively structured regeneration of a cellulose derivative to pure cellulose leads to surfaces with spatially separated wettabilities and different chemical functionality. Subsequent enzymatic digestion of the cellulose structures further allows the manufacturing of desired surface patterns.

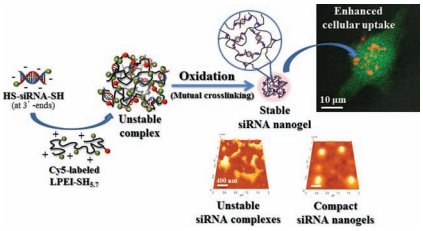


Thin Films

R. Kargl,* T. Mohan, S. Köstler, S. Spirk, A. Doliška, K. Stana-Kleinschek, V. Ribitsch*.....308–315

Functional Patterning of Biopolymer Thin Films Using Enzymes and Lithographic Methods

A highly condensed, stable nanogel comprising mutually crosslinked small interfering RNA (siRNA) and linear polyethylenimine (LPEI) via disulfide bonds within an individual polyplex shows greatly enhanced cellular uptake and gene-silencing efficiency. The reducible nanogels are disintegrated readily to biologically active siRNA and low-molecular-weight cationic fragments upon exposure to reductive conditions, allowing RNA interference (RNAi)-mediated gene silencing without severe cytotoxicity.

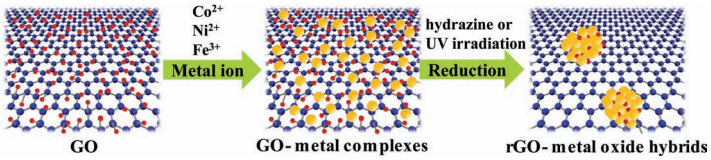


Biomedical Applications

C. A. Hong, J. S. Kim, S. H. Lee, W. H. Kong, T. G. Park, H. Mok,* Y. S. Nam*.....316–322

Reductively Dissociable siRNA-Polymer Hybrid Nanogels for Efficient Targeted Gene Silencing

The rare coexistence of ferromagnetism and electrical conductivity is observed in the reduced graphene oxide–metal oxide hybrids rGO-Co, rGO-Ni, and rGO-Fe. This is seen using chemical reduction with hydrazine or ultraviolet photoirradiation of the graphene oxide–metal complexes GO-Co, GO-Ni, and GO-Fe.

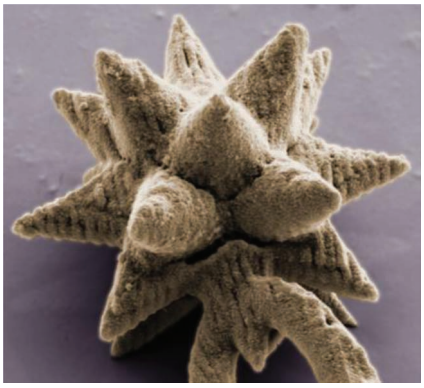


Graphene

M. R. Karim, H. Shinoda, M. Nakai, K. Hatakeyama, H. Kamihata, T. Matsui, T. Taniguchi, M. Koinuma, K. Kuroiwa, M. Kurmoo, Y. Matsumoto, S. Hayami*..... 323–332

Electrical Conductivity and Ferromagnetism in a Reduced Graphene–Metal Oxide Hybrid

Multiphoton lithography using a solid, protein-based reagent creates microstructures free from previous requirements for surface attachment. This approach is used to fabricate a broad range of microscale objects using several proteins. Free-floating 3D protein stars are confined with bacteria within microscopic chambers, providing a means to probe cellular activity using objects of defined shape. This method provides a tool for investigators to define and characterize cellular microenvironments.



Hydrogels

E. C. Spivey, E. T. Ritschdorff, J. L. Connell, C. A. McLennon, C. E. Schmidt, J. B. Shear*..... 333–339

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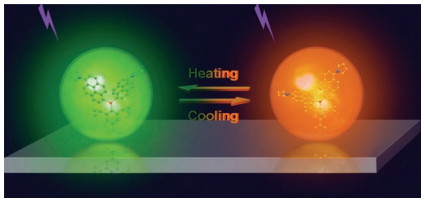
J. Feng, L. Xiong, S. Q. Wang, S. Li,* Y. Li,* G. Q. Yang* 340–345

Fluorescent Temperature Sensing Using Triarylboron Compounds and Microcapsules for Detection of a Wide Temperature Range on the Micro- and Macroscale



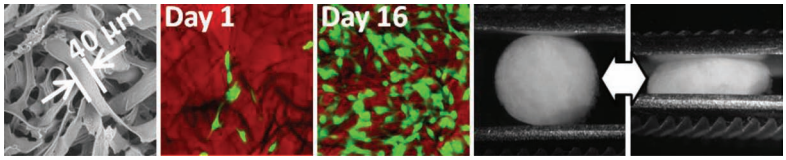
Single luminophore microcapsules are fabricated to detect temperature with a yellow-green to orange luminescence change over a wide temperature range (–30 to +140 °C). The microcapsules are demonstrated to be novel, reliable, and absolute luminescent microthermometers.

Tissue Engineering

L.-H. Han, S. Yu, T. Wang, A. W. Behn, F. Yang* 346–358

Microribbon-Like Elastomers for Fabricating Macroporous and Highly Flexible Scaffolds that Support Cell Proliferation in 3D

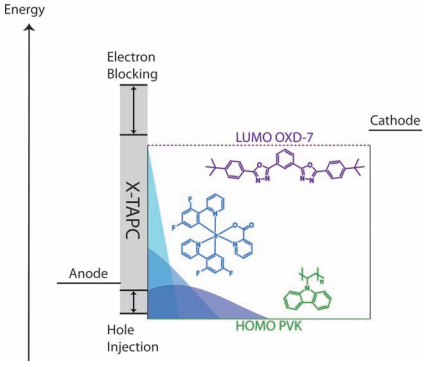
Microribbon-like photocrosslinkable elastomers show exceptional capability to form macroporous and highly flexible tissue engineering scaffolds that facilitate cell encapsulation and cell proliferation in three dimensions and sustain large compressive deformation (>90%) without failing. Such a scaffold could be useful for engineering shock-absorbing tissues such as cartilage and intervertebral discs.



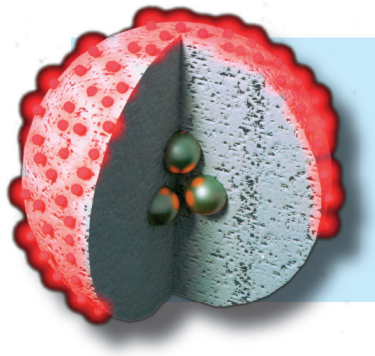
Light-Emitting Diodes

G. Liaptsis, K. Meerholz* 359–365

Crosslinkable TAPC-Based Hole-Transport Materials for Solution-Processed Organic Light-Emitting Diodes with Reduced Efficiency Roll-Off



The influence of varying hole-injection and electron-blocking properties is studied using different crosslinkable hole conductors of the 4,4′-(cyclohexane-1,1-diyl)bis(*N*,*N*-dip-tolylaniline) (TAPC) family in blue phosphorescent organic light-emitting diodes (OLEDs) consisting of polyvinylcarbazole (PVK)/bis[(4,6-difluorophenyl)pyridinato-N,C^2](picolinato) iridium(III) (FIrpic)/1,3-bis(5-(4-tert-butylphenyl)-1,3,4-oxadiazol-2-yl)benzene (OXD-7)-based solution-processed devices.



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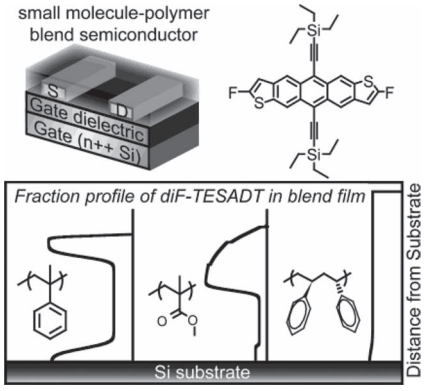
FULL PAPERS

Thin-Film Transistors

N. Shin, J. Kang, L. J. Richter, V. M. Prabhu, R. J. Kline, D. A. Fischer, D. M. DeLongchamp,* M. F. Toney, S. K. Satija, D. J. Gundlach, B. Purushothaman, J. E. Anthony, D. Y. Yoon*.....366–376

Vertically Segregated Structure and Properties of Small Molecule–Polymer Blend Semiconductors for Organic Thin-Film Transistors

Vertical phase segregation in blend films of an organic small molecule semiconductor, diF-TESADT, and various binder polymers are investigated. Comprehensive structural analysis reveals that the choice of polymer can strongly affect the structure of blend films due to the competing effects of confinement entropy, interaction energy, and solidification kinetics.

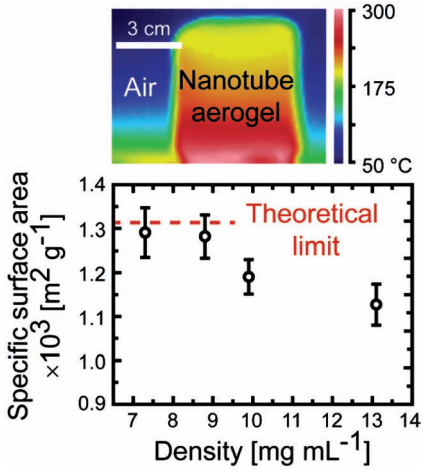


Carbon Nanotubes

K. H. Kim, Y. Oh, M. F. Islam*.....377–383

Mechanical and Thermal Management Characteristics of Ultrahigh Surface Area Single-Walled Carbon Nanotube Aerogels

Free-standing aerogels from single-walled carbon nanotubes (SWCNTs) with a specific surface area of 1291 $m^2\ g^{-1}$, which is close to the theoretical limit, and a Young's modulus that is higher than any other aerogels at comparable density are created. These aerogels enhance heat transfer by ≈85%, likely due to their large porosity and surface area.



Organic Electronics

V. Jankus,* E. W. Snedden, D. W. Bright, V. L. Whittle, J. A. G. Williams, A. Monkman.... 384–393

Energy Upconversion via Triplet Fusion in Super Yellow PPV Films Doped with Palladium Tetraphenyltetrabenzoporphyrin: a Comprehensive Investigation of Exciton Dynamics

Energy upconversion via triplet fusion is achieved in "super yellow" polymer films doped with sensitizer. The main upconversion efficiency loss mechanism is due to triplet quenching in sensitizer aggregates and this could account for a loss in the range of 76–99%. Preventing sensitizer aggregation in near-infrared-to-visible upconverting films is crucial and could lead to substantial increase of upconversion efficiencies.